WOOD TYPE GOLF CLUB HEAD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a wood type golf club head, and more particularly to a wood type golf club head with a faceplate that has a high specific strength outside and inside platewelded together with empty spaces to increase the coefficient of restitution (COR) of the faceplate.

2. Description of Related Art

The basic types of golf clubs are woods, irons and putters. Each type of club has a significantly different a head. To hit the ball powerfully and successfully, the head of the golf club is made of high strength material such as metal or composite materials.

A wood golf club head generally has a crown, a sole, a face with a center of impact or "sweet spot", etc. that are all well-known in this art. The sweet spot represents the spot of desired contact with the ball.

Some basic tendencies in wood club head design follow.

1. Maximize volume of the club head. The volume of a wood club head is 280 to 440 cc in recent years. To increase an area of the sweet spot for a successful swing, a wood club head with a volume of 450 to 520 cc may appear in the near future.

2. Lower the center of gravity of the club head. To achieve a stable swing and a successful hit, weights are mounted inside the club head on or near the sole to lower the center of gravity of the whole club head. The weights are typically tungsten-based or copper-based materials and weigh 10 to 80 grams. The

weights also increase the inertia the club head during the swing, cause the ball to travel a greater distance and increase the angle of flight off the club face.

3. Minimize drag on the club head. Since drag on the club head during a swing slows the club head and can make the club head unstable, computer aided design software is used to minimize drag on a club head by changing the shape of the club head.

4. Minimize shock and vibration and optimize sound caused when the club head strikes the ball. Harsh shock, vibrations and sound caused by the impact cause a golfer's swing to be inconsistent. The golf club head should meet ergonomic requirements.

Another factor that influences the flight of golf balls is the coefficient of restitution (COR) of the club face. COR relates to the energy transfer that occurs when the face of the club head strikes a golf ball. COR directly relates to the speed of the ball as it rebounds from the face and is typically in a range of 0.74 to 0.80 for stainless club heads or 0.80 to 0.85 for titanium (Ti) club heads. However, COR of club heads has improved continuously as new high specific strength materials are used in golf club heads where specific strength is the ratio of tensile strength to specific density. The high specific strength material, such as Society of Automotive Engineers (SAE) alloy No. 465, near β-phase titanium (Ti) alloy or the like will increase COR of the club head to approximately 0.88.

A conventional club head faceplate is formed by welding a reinforced homogenous plate between the crown and the sole of a club head. However, a conventional faceplate is not particularly flexible and does not increase the size of sweet spot and the COR of the club face. Because individual materials have

definite physical limitations due to the characteristics of the material, new club head configurations and features have been developed to improve the characteristics of the faceplate. For example, two plates made of different materials with different material characteristics have been combined or flexible materials have been used to form an improved faceplate. The flexible materials increase the toughness of the faceplate and the impact duration that helps the golfer to maintain ball velocity on off-center strikes. The tougher material can be used to fabricate a thin faceplate that also improves the COR. However, the stiffness and the toughness of the same material are inversely proportional material properties, which means the roughness decreases when the stiffness increases.

Therefore, conventional faceplates cannot simultaneously provide improved COR and high mechanical strength. Even though a faceplate can be fabricated with a combination of flexible plate to improve COR and a rigid plate to provide strength to overcome the foresaid shortcoming, the combination of the two plates is too heavy for the club head.

To overcome the shortcomings, the present invention provides a golf club head and method for fabricating the same to mitigate or obviate the aforementioned problems.

SUMMARY OF THE INVENTION

The main objective of the invention is to provide a golf club head with an improved faceplate that will provide a large sweet spot and an increase in the COR of the faceplate so the golf club head can hit a golf ball a further distance.

The faceplate comprises an outside plate and an inside plate. The outside

plate has a thickness of 1.0 to 2.0 millimeters and is made of high strength material. The inside plate has a thickness of 0.5 to 1.8 millimeters and is made of high strength material. The inside plate is hollow or is a mesh and is connected to the outside plate. Therefore, the outside plate provides strength and the inside plate provides flexibility to the faceplate. The COR of the faceplate will be improved, and the faceplate can be fabricated with a large area to increase sweet spot without reducing mechanical strength.

Other objectives, advantages and novel features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a wood type golf club head in accordance with the present invention;

Fig. 2 is an exploded perspective view of the golf club head in Fig. 1;

Fig. 3a is an exploded perspective view of a faceplate of the golf club head in Fig. 1;

Fig. 3b is an exploded perspective view of an alternative embodiment of the faceplate of the golf club head in Fig. 1;

Fig. 4 is a cross sectional side plan view of the faceplate in Fig. 3a;

Fig. 5a is an exploded perspective view of another embodiment of the faceplate of the golf club head in Fig. 1;

Fig. 5b is an exploded perspective view of another embodiment of the faceplate in Fig. 5a;

Fig. 6 is a table of results of impact tests for faceplates on a No.1 wood

with an inclination angle of 9.5° and a club head volume of 360 cc;

Fig. 7 is a graph of COR for items 1 to 6 in the table in Fig. 6;

Fig. 8 is a graph of COR for items 7 to 12 in the table in Fig. 6; and

Fig. 9 is a graph of COR for items 12 to 14 in the table in Fig. 6.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

With reference to Figs. 1 and 2, a golf club head (10) for a wood club in accordance with the present invention includes a body (11) and a faceplate (12). The body (11) can be made of high strength precipitation hardened (PH) stainless steel, titanium (Ti) alloy or other Fe-based high strength materials and has a top (not numbered), a bottom (not numbered), a hosel (110), a front face (111), a shank (112), a crown (113) and a sole (114). The crown (113) is formed on the top of the body (11). The sole (114) is formed on the bottom of the body (11). The shank (112) is formed on and extends from the top of the body (11). The hosel (110) is defined at the shank (112) to connect the golf club head (10) to a shaft (not shown). The front face (111) is formed on the body (11) between the crown (113) and the sole (114) and has a recess (115) in which the faceplate (12) is mounted.

With reference to Figs. 2, 3a, 3b and 4, the faceplate (12) is held firmly in the recess (115) in the front face (111) of the body (11) by welding, pressing or other means, and has a center of percussion (not numbered) called a "sweet spot." The faceplate (12) comprises an outside plate (121), an optional medial plate (122) and an inside plate (123) that are connected together by welding or other means. The outside plate (121) has a thickness and is made of high specific strength (i.e. the ratio of tensile strength to specific density) material, such as

titanium (Ti) alloy No. 2041 (Ti-20V-4Al-1Sn) that complies with Japanese Industrial Standards (JIS). The thickness of the outside plate (121) is 1.0 to 2.0 millimeters (mm).

The inside plate (123) has a thickness and one or more than one empty spaces (not numbered), and is also made of high specific strength material, such as the titanium alloy No. 2041 as previously described. With reference to Fig. 3a, the inside plate (123) has one empty space that is a through hole (not numbered) defined through the inside plate (123). The thickness of the inside plate (123) is 0.5 to 1.8 mm. With reference to Fig. 3b, a modified inside plate (123') can also be fabricated with a mesh such that the inside plate (123') contains multiple empty spaces.

The medial plate (122) is made of high toughness or ductile materials. Such a high toughness or ductile material is Society of Automotive Engineers (SAE) alloy No. 304. The medial plate (122) has a thickness that is 0.5 to 1.2 mm. The three plates (121, 122, 123) are connected together in sequence by welding or other means with the medial plate (122) is mounted between the outside and the inside plates (121, 123).

Each of the individual plates (121, 122, 123) would have a coefficient of restitution (COR) distributed across the plate (121, 122, 123) if mounted separately in the recess (115) in the front face (111) of the golf club head (10). However, the aggregate COR is distributed more evenly in the faceplate (12) formed by combining the multiple plates (121, 122, 123), which results in an enlarged sweet spot and more consistent golf shots.

With reference to Fig. 5a, another embodiment of a faceplate (not

numbered) comprises only an outside plate (121) and an inside plate (123) that have the same features previously described. The outside and the inside plates (121, 123) are connected together by welding or other means. With further reference to Fig. 5b, the faceplate (not numbered) can be implemented with an outside plate (121) and a modified inside plate (123') that is a mesh as previously described.

With reference to Figs. 1, 3a, 3b, 5a, 5b and 6, an "impact test" was performed to verify the effectiveness of the golf club head in accordance with the present invention relative to a conventional golf club head. The faceplates (12) tested were various combinations of the three plates (121, 122, 123, 123') and were attached to the front face (111) of a No.1 wood with an inclination angle of 9.5°, and a head volume of 360 cubic centimeters (cc).

With reference to Fig. 5a, items 1 to 3 in Fig. 6 have a faceplate comprised of an inside plate (123) with a through hole and an outside plate (121) that are made of titanium alloy No. 2041 (Ti-20V-4Al-1Sn).

With reference to Fig. 5b, items 4 to 6 in Fig. 6 have a faceplate comprised of an outside plate (121) and a meshed inside plate (123') that are made of titanium alloy No. 2041.

With reference to Fig. 3a, items 7 to 9 in Fig. 6 have a faceplate comprised of an inside plate (123) with a through hole, an outside plate (121) and a medial plate (122). The inside and the outside plates (121, 123) are made of titanium alloy No. 2041. The medial plate (122) is made of SAE alloy No. 304.

With reference to Fig. 3b, items 10 to 12 in Fig. 6 have a faceplate comprised of an outside plate (121), a medial plate (122) and a meshed inside

plate (123'). The inside and the outside plates (121, 123') are made of titanium alloy No. 2041. The medial plate (122) is made of SAE alloy No. 304.

Item 13 in Fig. 6 has a faceplate comprised of only an outside layer that is made of titanium alloy No. 2041. Item 14 in the Fig. 6 has a faceplate comprised an outside plate and an inside plate that are made of titanium alloy No. 2041, and the inside plate does not have any empty space. Items 13 and 14 in Fig. 6 reflect conventional designs and are for experimental comparison.

Measuring the COR at different points on the faceplate will verify changes in the COR distribution in the faceplate. With reference to Fig. 1 and 2, each faceplate (12) has a geometric center and an outer edge. COR of the faceplate (12) was measured at a central point A, an intermediate point B between the central point A and the edge and another intermediate point C between the central point A and the edge. The central point A is at the geometric center of the faceplate, point B is 5.5 mm from point A, and point C is 11.25 mm from point A.

With further reference to Figs. 7 to 9, the measured COR for items 1 to 14 were plotted to graphically present the COR distributions for each faceplate. The x-axis of the coordinate in the graphs represents a distance away from the geometric center of the faceplate, regarded as an origin point. The y-axis of the coordinate is COR.

The table and the graphs in Figs. 6 to 9 clearly show that the conventional faceplates, items 13 and 14, have the highest COR (0.865) at point A, and a golf ball struck by the conventional faceplates at or very near point A travels measurably farther than a golf ball struck by the faceplates in items 1 to

12. If one were to judge the performance of the tested faceplates based on distance alone, the conventional faceplates appear to be superior. Even though distance is certainly a significant performance parameter, consistency in distance is essential to club selection and scoring performance in golf. The table in Fig. 6 also includes a column to show the gradient of COR based on the COR at point A and point C. The gradient shows how quickly the COR drops as a position moves away from position A. Since a golf ball travels a measurably shorter distance when the COR is smaller, a golf ball will travel a much shorter distance when the faceplate strikes the golf ball just a few millimeters from point A. Therefore, a design objective for a faceplate would be to have a high maximum COR with a small COR gradient. The gradient column shows that faceplates in accordance with the present invention have a much more uniform COR distribution. Analysis of the distance the golf balls travel for each faceplate reveals that the maximum difference is just over 14 yards and in most cases is significantly less than 10 yards. Such small distances in a fairway are usually insignificant and will not affect second shot club selection for most golfers.

In conclusion, a faceplate with an inside plate with a hollow or meshed feature inside the outer faceplate and a medial plate in the faceplate will make the flight of a golf ball more consistent and will ultimately improve a golfer's score.

Even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and

arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.